

**STATE OF WASHINGTON AUGMENTED ANADROMOUS
FISH HEALTH MONITORING**

ANNUAL REPORT 1986

Prepared By

**Kevin Anos,
Kathleen Hopper,
Patty Michak and
Bob Rogers**

**Washington State Department of Fisheries
115 General Administration Building
Olympia, Washington 98504**

and

**Jim Gearheard,
Steve Roberts,
Don Chase and
Bruce Bolding**

**Washington Department of Wildlife
600 N. Capital Way E.
Olympia, Washington 98504**

Funded by

**Ron Morinaka, Project Manager
U.S. Department of Energy
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May 1987

Augmented Fish Health Monitoring

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Columbia River Basin Fish and Wildlife Program Measure 704(f)(1)

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INTRODUCTION

Natural anadromous salmonid production in the Columbia River Basin has decreased due to hydroelectric facilities and other causes. Artificial propagation of fish is the typical means of mitigating this loss. The survival of these hatchery smolts varies widely between locations and years. This study will provide data to improve the health, quality, and thus survival of artificially produced smolts.

Bonneville Power Administration formed an interagency technical committee to determine the minimum level of fish health monitoring needed in the Columbia Basin. Members include both administrative and technical personnel from four state agencies, and from the U. S. Fish and Wildlife Service. The committee developed a monitoring program which includes agreed upon levels of testing in these areas: specific fish health parameters, water quality, and prevalence of certain pathogens. BPA's funding enabled the Washington Department of Fisheries to expand its' fish health monitoring in the 14 Columbia River hatcheries to the level set forth by this group.

MATERIALS AND METHODS

Examinations of hatchery fish in the Columbia River Basin hatcheries listed in Figure 4 were conducted by staff fish pathologists who are certified by the American Fisheries Society as either a Fish Pathologist or Fish Health Inspector or both. All sampling of adults and smolts were conducted by staff fish pathologists or fish biologists or supervised by the above. The examinations and sampling were conducted on site, and the samples shipped or carried directly to Olympia, Washington.

The Washington Department of Fisheries Virology Lab is located on the Evergreen State College campus, in Olympia. The computer work and blood slide work is also done at that location. Another lab is located at the Salmon Culture Office in downtown Olympia. Bacteriology, M. *cerebralis* processing and office staff support comes from that location.

Adults

Fish health monitoring of the 1986 returning adult salmon involved virus screening at all Washington Department of Fisheries Columbia River Basin stations. Returning adults were sampled for the presence of Infectious Hematopoietic Necrosis Virus (IHNV) and Infectious Pancreatic Necrosis Virus (IPNV) at stations listed in Appendix B, according to Section 1 (General Sampling Procedures) of the AFS Fish Health Blue Book (Ams, 1985). Increased sampling was conducted at facilities that had a prior history of virus incidence. 471 viral testing procedures were conducted as per Section 2 (Methods for the Detection of Certain Viral Agents) of the AFS Fish Health Blue Book (Ams, 1985).

**Figure 4. Summary of WDF Hatcheries and Stocks
for BPA - Fish Health Monitoring Program**

<u>Hatchery</u>	<u>Stock</u>
Lower Kalama	Early coho Fall chinook (tule)
Kalama Falls	Late coho Fall chinook (tule) Spring chinook "Upriver Brights" (U. B.) Fall chinook
Lewis River	Spring chinook Fall chinook (tule) Coho
Speelyai	Coho
Priest Rapids	(U. B.) Fall chinook (yearlings and 0's)
Ringold	(U. B.) Fall Chinook
Washougal	Early coho Late coho Fall chinook (tule)
Wells	Summer Chinook (yearlings and 0's)
Elokomin	Coho Fall chinook (tule)
Klickitat	Fall chinook (tule) Spring chinook Coho
Lyons Ferry	U. B. Fall chinook Spring chinook
Rocky Reach	Summer chinook Coho
Grays River	Fall chinook (tule) Coho
Cowlitz River	Spring chinook Fall chinook (tule) Coho

Juveniles

Monthly monitoring visits began in September 1986 (Appendix A). All stocks and brood years on Columbia Basin hatcheries were evaluated by the visiting pathologist to determine their general overall health condition. Routine exams include: external appearance, eye condition, fin integrity, gill condition, external and gill parasite prevalence, internal organ color and quality. In addition, the disease status of moribund fish and a cause for an increase in loss is determined by the appropriate method (gram stain, wet mount, bacterial culture, tissue culture, etc.) as determined by the pathologist.

Beginning January 1987, stocks were also monitored monthly for Yersinia ruckeri (ERM), Aeromonas salmonicida (furunculosis) and coldwater disease as per Section 3 (Methods for the Detection of Certain Bacterial Diseases) of the AFS Fish Health Blue Book (Amos, 1985).

Computerization of the monthly monitoring data collection began in January 1987, with the development of fish health data collection forms (Appendix G):

- 1) FH01 - Fish Health Monitoring Report (Part 1). This is the pathologist's examination report.
- 2) FH02 - Fish Health Monitoring Report (Part 2). This is the monthly summary of hatchery conditions.
- 3) FH03 - Medication and Mortality Report. This is a worksheet for hatchery personnel to track daily mortality, cause of mortality, and record chemotherapy and other treatments. A data management

program (dBase III plus) is being developed by a computer specialist to compile monthly monitoring data and generate status reports.

Pre-release examinations of smolting juveniles have begun on stocks listed in Figure 4. Appropriate tissue samples and blood were taken from 60 asymptomatic fish. In addition, when possible, moribund fish were sampled. Assays on these tissues were conducted in accordance with the AFS Blue Book (Ams, 1985) for the following pathogens: Infectious Hematopoietic Necrosis Virus, Infectious Pancreatic Necrosis Virus, Erythrocytic Inclusion Bodies (Viral Erythrocytic Necrosis), Renibacterium salmoninarum and Myxobolus cerebralis (Myxosoma cerebralis in Blue Book). Organosomatic analyses, based on Goede's method (personal communication, 1987), were performed on 3 of the 4 index stocks. Hematocrits, lengths and weights were also taken on all stocks. At this writing, we have approximately half of the pre-liberation exams complete.

RESULTS AND DISCUSSION

The first year of the project involved equipping and staffing Washington Department of Fisheries to complement existing personnel and facilities for full ability to complete the task. At the same time, we were conducting fish health monitoring, educating our hatchery personnel and planning the next 4 years of the project. The results of adult viral monitoring in 1986 are complete, monthly monitoring of fish is ongoing, and the 1987 smolt monitoring results are incomplete due to timing of this report. Future annual reports will include full reports on stocks beginning with 1986 brood.

Analysis of the project's benefits will involve examining fish health data for Columbia Basin stocks from brood years 1983, 1984 and 1985.

Clarification of this task is in progress with the Project Technical Steering Committee and BPA.

Water quality analysis will be completed when Bonneville Power Administration designates the contractor for this task and will be detailed in future reports (see Appendix E, Water Sampling Plan).

Monthly monitoring visits that are computerized are listed in Appendix A. We have no significant findings from the monthly monitoring to date. The information obtained will be relevant when the pre-release checks on these stocks are complete and hatchery records are finalized.

Adult inspection results from 1986 adults is summarized in Appendix B. All stocks were negative for IHNV, IPNV and other replicable agents.

Appendix C lists the results of the pre-release examinations on the 1985 brood spring and fall chinook yearlings and the 1985 brood coho yearlings.

All stocks tested negative for IHNV, IPNV and other replicable agents. The average incidence of erythrocytic inclusion bodies among the stocks was 78.7%. The presence of viral particles in these erythrocytes was not confirmed by electron microscopy in any of these cases.

The analysis of hatchery parameters as related to fish health will be incomplete until pre-release checks on all stocks and hatchery records are finalized. However, the response from Columbia Basin hatchery managers and fish culturists has been favorable. The increased awareness of these key personnel has undoubtedly already affected the quality of fish health monitoring on all Columbia River Basin hatcheries.

ACKNOWLEDGMENTS

Fish Pathologists: Dick Westgard, Mark DeCew, Tami Black.

Laboratory Staff: Bruce Bolding, Jennifer Hullett

Computer Specialist: Tony Rasch

Ron Goede

Typist: Fran Walch, Barbara Burfoot

Operations Manager: Lew Atkins

Hatchery Managers: Paul Peterson, Ed Jouper, Dick Aksamit, Bob Ready, John Norton, Doug Loucks, Robin Nicolay, Steve Decker, Carl Ross, Ernie Davis, Frank Anderson, Don Rapelje, Dick Johnson and Jerry Mboore.

All hatchery crews.

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Personal Communication, 1987.

Appendix A Summary of Monthly Monitoring Visits *

<u>Hatchery</u>	<u>January</u>	<u>February</u>	<u>March</u>	<u>April</u>
Cowlitz	0	1	1	
Elokomin	1	2	1	
Grays River	1	1	1	
Kalama	0	1	1	
Klickitat	1	1	1	
Lewis River	0	1	1	
Lower Kalama	0	1	1	
Lyon's Ferry	1	1	1	1
Priest Rapids	1	1	1	1
Ringold	1	1	1	1
Rocky Reach	1	1	1	
Speelyai	0	1	2	
Washougal	0	1	2	
Wells	1	1	1	

* All Hatcheries visited monthly September through December.
Computerized data summary began January, 1987.

Appendix B Summary of Adult Health Inspections-1986

<u>Hatchery</u>	<u>Species</u>	# Pools	IHN		#Pools	IPNV	
			# fish	<u>Pos/Neg</u>		# Fish	<u>Pos/Neg</u>
Cowlitz	springs	61	303	N	12	60	N
	falls	57	282	N	12	60	N
	late coho	12	60	N	12	60	N
Elokomin	falls	12	60	N	12	60	N
	coho	12	60	N	12	60	N
Grays River (October)	falls (Grays)	12	55	?*	12	55	N
	falls (Skamakawa)	12	59	N	12	57	N
Grays River (November)	falls (Grays)	31	93	N	--	--	-
	falls (Skamakawa)	4	8	N	--	--	-
	coho	12	60	N	12	60	N
Kalama Falls	springs	11	55	N	11	55	N
	falls	12	60	N	12	60	N
	early coho	12	60	N	12	60	N
	falls (Tucanon)	18	88	N	18	18	N
	late coho	12	60	N	12	60	N
Klickitat	springs	12	60	N	12	60	N
	coho	11	52	N	8	38	N
Lewis River	late coho	12	60	N	12	60	N
Lyon's ferry	springs	16	48	N	16	49	N
	falls	32	138	N	15	63	N
Priest Rapids	falls		277**	N		92**	N
Speelyai	springs	18	87	N	12	60	N
	coho	12	60	N	12	60	N
Washougal (November)	falls	12	60	N	12	60	N
	coho	111	555	N	12	60	N
	falls	43	128	N	--	--	-
Wells	late coho	12	60	N	12	60	N
	summers	149	734	N	12	60	N

* Two very small suspicious plaques found, continued sampling adults in November no virus found,

** All samples tested by ODFW due to egg shipment to Bonneville hatchery, WDF personnel assisted in sample collection,

Appendix C Summary of Smolt We-Release Examinations

<u>Hatchery</u>	<u>Brood</u>	<u>Stock</u>	<u>Species</u>	<u>IHN</u>	<u>IPNV</u>	<u>EIB</u>	<u>Hematocrit</u>		
	<u>Year</u>						<u>Avg</u>	<u>High</u>	<u>Low</u>
Cowlitz	'85	Cowlitz	springs	N	N	56/59	36.2	44	23
Elokanin	'85	Elokanin	late coho	N	N	7/60	36.9	49	29
Grays	'85	Grays	early coho	N	N	51/60	29.1	40	3
Kalama Falls	'85	Kalama	late coho	N	N	42/60	33.5	41	25
Klickitat	'85	Klick.	springs	N	N	49/60	41.0	54	30
	'85	Klick.	late coho	N	N		40.6	48	27
Lewis	'85	Lewis	springs	N	N	60/60	35.9	47	26
	'85	Lew/Spl	late coho	N	N	51/60	35.3	45	27
Lower Kalama	'85	L.Kal.	early coho	N	N	45/60	37.9	53	28
Lyon's Ferry	'85	Tucannon	springs	N	N	28/30	40.2	51	33
	'85	Lyon's	falls (UB)	N	N	52/60	43.7	52	35
Ringold	'85	Ringold	falls	N	N	54/60	41.4	51	28
washougal	'85	Wash.	early coho				29.4	39	19

Examination results for M.cerebralis and R.salmoninarum not yet available

APPENDIX D

Table 2.1

Analyses	Life Stage	Samples Per Lot	Fish Lots	Frequency of Sampling	Methods/Remarks
I. <u>PHYSIOLOGICAL ANALYSES</u>					
A. <u>Physiological Quality:</u>					
1. Organosomatic Analyses	Smolt	60	all	Pre-lib	Do only BPA approved species at " <u>index locations</u> " (Cowlitz fall chinook, spring chinook; Lower Kalama coho; Lyon's Ferry fall chinook) use method of Goede. ^{-1/}
II. <u>WATER PARAMETERS</u>					
1. Flow Index	all	1	all	Monthly	Use Piper et al. ^{-2/}
2. Loading Density	all	1	all	Monthly	Use Piper et al. ^{-2/}
3. Sample water supply	N/A	N/A	N/A	Twice/year	Refer to water sampling schedule.
III. <u>MONTHLY VISIT</u>	Juvenile	10	all	Monthly	Examine moribund fish if < 10 moribund found; then balance to 10 with healthy fish. Use appropriate techniques as described in section IV.
IV. <u>INFECTIOUS DISEASES</u>					
A. <u>Parasitic Diseases:</u>					
1. Whirling Disease (M. <u>cerebralis</u>)	Smolts (4-12 mos.)	60	most susceptible species only	Pre-lib	Only sample in surface water supplies, unless typical signs are present. Use AFS (1985). ^{-4/}
2. Ceratomyxosis (C. <u>shasta</u>)	Juvenile Adult	10 up to 20	all all	Monthly Annually	Sample morts in surface water supplies only, June through October. Consider as a factor in pre-spawning mortality. Use AFS (1985). ^{-4/}
3. Proliferative Kidney disease (PKX)	Juvenile Smolt moribund	10	all		Sample morts in surface water supplies, if kidneys are swollen. Analysis by histopath. ^{-5/}

Table 2.1

Analyses	Life Stage	Samples Per Lot	Fish Lots	Frequency of Sampling	Methods/Remarks
B. Viral Diseases:					
1. Infectious Hematopoietic Necrosis (IHN)	Juvenile	10 [number is minimal]	all	If clinical signs exist,	Tissue culture, Use AFS (1985). ^{4/}
& Infectious Pancreatic Necrosis (IPN)	Smolt	60+	all	Pre-lib	Tissue culture. AFS (1985). Sample 60 heal thy fish plus a separate group of moribund fish,
	Adult	60	all	At spawning	Tissue culture, AFS (1985).
2. Erythrocytic Necrosis (VEN)	Juvenile	Sample moribund, if anemic, CWD, BKD, or fungus are present,			Blood smear, Use AFS (1985).
	Smolt	60	all	Pre-lib	
	Adult	60	all	At Spawning	
C. Bacterial Diseases:					
1. Bacterial Kidney Disease (R. <u>salmoninarum</u>)	Juvenile	60	all	Mid-term	Use florescent antibody technique (FAT), Use AFS (1985). ^{4/} One fish pool,
	Smolt	60	all	Pre-lib	
	Adult	60	all	At spawning	
2. Coldwater Disease (C. <u>psychrophila</u>)	Fry-Smolt		all	When typical CWD mortality is occurring,	Gram stain confirmation,
3. Furunculosis (A. <u>Salmonicida</u>)	Fry-Smolt	up to 10	all	When FUR suspect mortality is occurring,	Culture on TSA media, AFS (1985). ^{4/}
	Adults	up to 20 morts.	all	Pre-spawning mortality,	
4. Enteric red mouth (Y. <u>ruckeri</u>)	Fry-Smolt	up to 10	all	When ERM suspect mortality is occurring.	Culture on TSA media, AFS (1985). ^{4/}
	Adults	up to 20 morts.	all	Pre-spawning mortality,	

Summary of Analysis

- I. PRE-LIB ANALYSIS: all lots
 - A. Organosomatic Analysis at index stations.
 - B. Viral Assay:
 - 1. IHN & IPNV: 60+ fish, Tissue culture, AFS (1985). Sample 60 healthy fish plus a separate group of moribund fish.
 - 2. Erythrocytic Necrosis (EIB): 60 fish. Blood smear, AFS (1985).
 - C. BKD Analysis: 60 fish. Kidney smear, FAT, AFS (1985). One fish pool.
 - D. M. cerebralis: examine most susceptible species for spores. In the case of more than one hatchery in a watershed, the most susceptible species will be examined to certify the watershed. Refer to AFS (1985).
- II. ADULT ANALYSIS: all lots
 - A. Viral Assay:
 - 1. IHN & IPNV: 60 fish. Tissue culture, AFS (1985).
 - 2. Erythrocytic Necrosis (EIB): 60 fish, Blood smear, AFS (1985).
 - B. Bacterial Analysis:
 - 1. BKD: 60 fish. Kidney smear, FAT, AFS (1985). One fish pool.
 - 2. Furunculosis: take cultures when pre-spawning mortalities indicate, AFS (1985).
 - 3. Enteric red mouth: take cultures when pre-gaming mortalities indicate, AFS (1985).
 - C. Ceratomyxosis (C. shasta): sample pre-spawning mortalities, AFS (1985).
- III. JUVENILE REARING ANALYSIS: all stations, all lots
 - A. Water Parameters
 - 1. Flow Index: monthly, all lots, Piper et al (1982).
 - 2. Loading Density: monthly, all lots, Piper et al (1982).
 - 3. Sample Water supply twice yearly, refer to water sampling schedule.
 - B. Monthly Visits: all lots will be examined. Attempt to examine 10 moribund fish. If < 10 moribund fish are available make up the difference with healthy fish. Appropriate diagnostic techniques will be used at the discretion of the examiner (tissue culture, gram stain, bacterial culture, blood smear, FAT, etc.).
 - C. Parasitic Analysis:
 - 1. Ceratomyxosis: 10 fish, June through October in surface water supplies only.
 - 2. PKX: 10 fish, morts in surface water supplies, if kidneys appear swollen.
 - D. Viral Analysis:
 - 1. IHN & IPNV: 10 fish, if clinical signs exist. Tissue culture, AFS (1985).

2. Erythrocytic Necrosis (EIB): sample ~~moribund~~ if anemic, CWD, BKD, or fungus are present. Blood smear AFS (1985).
- E. BKD: mid-term 60 fish. Kidney smear, FAT, AFS (1985).
one fish pool.

APPENDIX E**WATER SAMPLING PLAN
FOR BPA PROJECT #7906**

**Submitted by
Washington Department of Fisheries**

Table 1.

<u>Facility</u>	<u>Water source to be tested</u>
Grays River	(1) West Fork Grays River; (2) Unnamed spring; (3) Rainey well
Weyco Pond	(1) Alder Creek; (2) Grays River
E lokomin	(1) Elokomín River; (2) Clear Creek; (3) Unnamed stream
Cowlitz	Cowlitz River
Lower Kalama	(1) Fallert Creek; (2) Kalama River
Kalama Falls	(1) Unnamed stream (west of river); (2) Unnamed stream (east of river); (3) Kalama River
Gobar Pond	Gobar Creek
Lewis River	(1) Lewis River; (2) Unnamed stream
Speelyai	Speelyai Creek
Washougal	(1) Bobs Creek; (2) Boyles Creek; (3) Unnamed stream (4) Washougal River
Klickitat	(1) Indian Ford Springs (2 diversions); (2) Wonder Springs; (3) Klickitat River
Ringold	(1) Ringold Springs (2 diversions)
Priest Rapids	(1) Columbia River; (2) wells
Rocky Reach	(1) Columbia River; (2) seepage around dam
Wells Dam	(1) Columbia River; (2) wells
Lyons Ferry	Wells

<u>Parameters</u>	<u>Testing frequency</u>	<u>Tester</u>
Dissolved oxygen	Weekly	WDF
Temperature	Daily	WDF
pH	Monthly	WDF
Flow	Monthly	WDF
Hardness	Twice/Year	BPA contractor (not WDF)
Alkalinity	Twice/Year	BPA contractor (not WDF)
Nitrate	Twice/Year	BPA contractor (not WDF)
Nitrite	Twice/Year	BPA contractor (not WDF)
Total ammonia	Twice/Year	BPA contractor (not WDF)
Settleable solids	Twice/Year	BPA contractor (not WDF)
Suspended solids	Twice/Year	BPA contractor (not WDF)
Dissolved solids	Twice/Year	BPA contractor (not WDF)
Iron	Once/Year	BPA contractor (not WDF)
Manganese	Once/Year	BPA contractor (not WDF)
Lead	Once/Year	BPA contractor (not WDF)
Mercury	Once/Year	BPA contractor (not WDF)
Zinc	Once/Year	BPA contractor (not WDF)
Cadmium	Once/Year	BPA contractor (not WDF)
Chromium	Once/Year	BPA contractor (not WDF)
Copper	Once/Year	BPA contractor (not WDF)
Total dissolved gas	Twice/Year	WDF
Total nitrogen gas	Twice/Year	WDF
PCB, Organophosphates	Once/Year	BPA contractor
Herbicides and defoliants	(on surface waters where applicable)	

Methodology

Samples will be collected twice annually (except where noted) from each hatchery water supply listed in Table 1; one sample each shall be collected during the period of seasonal high flow and low temperatures (i.e. winter) and during seasonal low flows and high temperature (i.e. summer). Tests to be conducted only once a year will be done during summer low flow.

Samples will be collected by WDF personnel. Tests to be done by WDF will use WDF equipment and reagents supplied by project 7906.

WDF will collect samples for BPA water quality contractor (other than WDF) with containers and shipping apparatus supplied by BPA contractor.

APPENDIX F - PROPOSED CAPITAL HATCHERY IMPROVEMENTS

An element of our contract (Task 2.3 - see statement of work, Appendix D) requires that the Washington Department of Fisheries (WDF) provide Bonneville Power Administration (BPA) with a list of "Facility Impediments" to fish health at each hatchery on the project. We are also required to itemize the benefits and costs of improving or removing these impediments. Some of these changes may require capital construction or providing equipment previously unavailable. Other impediments may be items such as lack of training or communication which require no construction, yet require a commitment of resources.

The list of projects to improve fish health at existing facilities may include generic items applicable at all stations, but may result in high benefits at some stations and low benefits at others. It is also necessary to mention that at specific sites with specific stocks, benefits accrued vary from year to year. Therefore, we will identify expected benefits either as high, medium or low. One must also recognize our cost estimates are "guesstimates" as of May 1, 1987. Finally, the projects listed do not necessarily increase production at the listed facility, but merely ensure that we meet current program goals with healthy and contributing animals.

Generic Impediments

<u>I tern</u>	<u>cost</u>	<u>Benefits</u>
Training in Fish Health and Husbandry	\$10,000/facility	Medium
Computers & training for operation	10,000/facility	Medium
Disinfection of Surface Water at Hatcheries and/or Increasing Ground Water Use	\$300-500,000/facility (does not include O/M)	Low to High Very site-specific
Modification of Adult Holding Ponds in order to apply chemotherapeutants and injections, and easily handle.	\$200,000/facility	High
Installation of Charcoal Filtration Units to remove chemotherapeutants from effluent	\$10-100,000/facility	Highest
Cleaning Mechanisms for Large, Asphalt Rearing Ponds	\$20,000/facility (does not include O/M)	Medium
Bird Covers for Ponds	\$15,000/facility (some sites already covered)	High
Construction of new ponds or modification of existing ponds for optimum early rearing	\$150,000/facility	Medium
Modification of smolt ponds to allow volitional outmigration (some currently acceptable)	\$150,000/facility	High Very site-specific
Ability to accurately measure flow of water into ponds	950,000/facility	Medium

Site Specific Impediments

<u>Facility</u>	<u>Impediment</u>	<u>cost</u>	<u>Benefits</u>
Grays River	Stabilize intake	\$200,000	High
	Asphalt a dirt pond	75,000	Medium
	Bird cover	15,000	High
Elokomin	Asphalt a dirt pond or build concrete raceways.	300,000	Medium
	Build adult pond at lower rack.	500,000	High
	Bird cover	15,000	High
Lower Kalama	Asphalt dirt pond	150,000	Medium
	Fix valves	50,000	Medium
Kalama Falls	New adult pond & ladder	300,000 (plus 200,000 generic items)	High
	Settling pond for influent	100,000	Medium
	Reconstruction of inefficient raceways.	500,000	Medium
Washougal	"Formalize" Boyle Creek Pond	300,000	Medium
Lewis River	Increase pump capacity	150,000	Medium
Speelyai	See generic items		
Klickitat	Smolt transfer pipe	50,000	Medium
	Acclimation pond	250,000	Medium
	Asphalt Wonder Spg. pond	150,000	Medium
Cowlitz	Acclimation pond for yearling releases	250,000	Medium
	Modification of smolt release system	100,000	High
Ringold	Cover and channel springs	50,000	Medium
	Develop outfall and trap	150,000	Medium
Priest Rapids	Adult holding pond	300,000 (+200,000 gen.)	High

<u>Facility</u>	<u>Impediment</u>	cost	<u>Benefits</u>
Lyons Ferry	Water treatment system to increase hardness of water.	m, 000 (does not include 0/M)	High
Wells	Adult holding & sorting pond.	300, 000	High
	Develop groundwater	200, 000	High

APPENDIX G

Form FH01 FISH HEALTH MONITORING REPORT (Part 1)

Location: _____ Date: _____ / _____ / _____
 month day year

Lot Description: _____
 species stock brood sub-group

Exam Type: _____ Size: _____ Mortality: _____
 [Monit-M,Diag-D,Pre-P,Cert-C] [Egg-E,Juv-#/lb,Adult-AA1 [Nor-N,Inc-I,Epi-E]

Ave % daily loss: _____ %

*** SAMPLE SIZE ***

*** SAMPLE SIZE ***

Type Pathogen Hlthy Morib Total #Pos Type Pathogen Hlthy Morib Total # Pos

*	*	*	*	*	11	*	*	*	*	*
*	*	*	*	*	11	*	*	*	*	*
*	*	*	*	*	11	*	*	*	*	*
*	*	*	*	*	11	*	*	*	*	*

[Viral: IHN,IPN,EIB Bact: BKD,CWD,FUR,ERM Paras: M.c,C.s,PKX1

POND TEMP LOSS POPUL %LOSS F/LB FLOW LBS/GPM LBSFED/DAY

1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1

Diagnosis, Recommendations, Remarks:

Examiner: _____

Case Number: _____ 1 2 0 3

Location: _____

Information for: _____
month year

Lot Description: _____
Species stock Brood Sub-group

Pond#(s)	Number of fish	Fish/Pound	Total Pounds of Food for month	Water Inflow gpm	Pond Volume cu ft	% Reuse	Total Number of Morts for Month	Remarks
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TOTAL:				:	:	:LAST DAY OF MONTH		

FISH INFO: Ave Lth _____ in.

DIET INFO:
Type _____
Pellet Size _____
Lot Number _____

WATER INFO:
Max Temp _____
Range lowest highest

* MORTALITY *				**** MEDICATION RECORD ****			EFFICACY				
Agent	Number	OR Pct	Type	Dosage	Amount		1	2	3	4	5
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Location: _____

Information for: _____
month _____ year _____Lot Description: _____
Species _____ Stock _____ Brood _____ Sub-group _____

Day	***** Medication *****			** Total . .		** Daily Mortality Due to Specific Agent ** (specify)								other	
	Type	Dosage	Amount	Number	Cumul	IHN	IPN	EIB	BKD	CWD	FUR	ERM	C.S		
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
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25															
26															
27															
28															
29															
30															
31															
TOTAL															

APPENDIX H

TECHNOLOGY TRANSFER PLAN

Bonneville Power Administration (BPA) recognizes the importance of communication between all fish managing entities in the Columbia Basin. The Washington Department of Fisheries is directed in Task 2.2 of their "Augmented Fish Health Monitoring" contract (see Appendix D) to develop for BPA approval, a plan to accomplish technology transfer and efficient communication between personnel in Fisheries management, hatcheries, research, and the Power Planning Council. The plan which we propose contains three elements, some of which are currently being accomplished by BPA.

First, the managing entities must have the ability to exchange fish culture and fish health data rapidly. Each group has different methods of collecting data. Though it would be easier for programming and data analysis if all fish health managers used the forms which we have already developed and submitted to BPA (see Appendix G), each entity may have needs for data collection not reflected in our forms. The solution to this problem could be the existence of a single clearing house which accepts data in many different formats from different managers but collates the "designated" statistics and delivers an output whose information is the same for all contributors. By approaching the technology transfer problem with the above solution, nobody dictates the methodology or scope of data collection for each entity but allows for presentation of critical data in a similar manner.

Second, in addition to publishing annual reports and circulating them to fisheries offices, we recommend that BPA publish an extensive monthly or quarterly report on the research, studies and fish health concerns of all managing parties. This newsletter would have wide circulation to include all

managers, hatcheries, and the Council. This newsletter would have informational and educational value.

Finally, I think BPA should continue sponsoring presentation by contractors at fish culture and fish health meetings. These talks have informational and educational value not only to technicians in a special field, but to all personnel associated in any manner with the fisheries resource.

Augmented Fish Health Monitoring
For
Washington Department of Wildlife
1986 Annual Report

by
Jim Gearheard
Steve Roberts
Don Chase
Bruce Bolding

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**Augmented Fish Health Monitoring
For
Washington Department of Wildlife
1986 Annual Report**

Introduction:

The Northwest Power Planning Council (NWPPC) has determined that there is insufficient data available to adequately prioritize artificial production improvements in the Columbia River drainage. This was evident in NWPPC program measure 704(f), hatchery survey. This project, funded by Bonneville Power Administration (BPA) and carried out by Washington Department of Wildlife (WDW), will collect and summarize fish health data at anadromous game fish production stations in Washington State operated by the contracted agency. This project is part of a basin-wide effort to accomplish augmented fish health monitoring and data collection in a standardized manner.

It is hoped that this increased monitoring will uncover impediments to production of high quality smolts and document these problems. Many problems exist and are well known. Good data to document these problems is lacking. Eventually it is hoped there will be sufficient data to justify improvements at artificial production facilities that will correct fish health problems and in turn improve smolt quality. The bottomline of course is more effective production programs resulting in more adult fish back to spawn or to contribute to fisheries. Index hatcheries with tagged fish releases will provide additional information as to whether or not increased fish health monitoring by itself will provide an improved product and greater returns. Operational changes without capital expenditures might result in a 20% increase in survival if problems are uncovered and corrected.

Description of Study Area:

This project is designed to collect and summarize fish health related data from VDW anadromous production facilities in the Columbia River drainage. Figure 1 indicates the location of these facilities. VDW rears winter-run steelhead, summer-run steelhead and sea-run cutthroat in these facilities although not all three species/strains are located at each of these stations. Table 1 indicates the rearing program at the facilities included in the study.

FIGURE 1



TABLE 1

VDW Columbia River Basin Anadromous Fish Rearing Programs

<u>Instal lat ion</u>	<u>Locat ion (Figure 1)</u>	<u>Drainage</u>	<u>Annual Program</u>
Beaver Cr. Hatchery	1	E iochonan	Winter SH Smolts Winter SH Pre-Smolts for 2 and 7 Summer SH Smolts Summer SH Pre-Smolts for 5 Searun CT Smolts Searun CT Pre-Smolts for 3 2 Broodstocks
Coweeman SH Pond	2	Coweeman	Winter SH Smolts
Coweeman CT Pond	3	Coweeman	Searun CT Smolts
Alder Creek Pond	4	Tout le	Summer SH Smolts
South Toutie Trap	5	Tout ie	Winter SH Smolts Summer SH Smolts
Cowlitz Hatchery	6	Cowl itz	Winter SH Smolts Summer SH Smolts Searun CT Smolts 3 Broodstocks
Gobar Pond	7	Kaiama	Winter SH Smolts Summer SH Smolts
Merwin Net Pens	8	Lewis	Summer SH Smolts
Vancouver Hatchery	9	L. Columbia	Summer SH Smolts Summer SH Fingerling for 10 Winter SH Fingerling for 10
Skamania Hatchery	10	Washouga I	Winter SH Smolts Summer SH Smolts Summer SH Pre-Smolts for 4, 7 and 8 Searun CT Smolts 3 Broodstocks
Yakima Hatchery	11	Yak ima	Summer SH Smolts Summer SH Fingerling for 12 1 Broodstock
Nelson Springs Raceway	12	Naches 4.	Summer SH Smolts

TABLE 1 (Continued)

WDW Columbia River Basin Anadromous Fish Rearing Programs

<u>Installation</u>	<u>Location (Figure 1)</u>	<u>Drainage</u>	<u>Annual Program</u>
Naches Hatchery	13	Naches	None this year
Ringold Pond	14	U. Columbia	Summer SH Smolts
Columbia Basin Hatchery	15	Crab Creek	Summer SH Fingerling for 14
Turtle Rock Pond	16	U. Columbia	Summer SH Smolts
Cheian PUD Hatchery	17	U. Columbia	Summer SH Smolts Summer SH Fingerling for 16 1 Broodstock (from 14)
Wells Hatchery	18	U. Columbia	Summer SH Smolts 1 Broodstock
Lyons Ferry Hatchery	19	L. Snake	Summer SH Smolts Summer SH Pre-Smolts for 20 and 21 1 Broodstock
Cur I Lake	20	Tucannon	Summer SH Smolts
Cottonwood Pond	21	Grande Ronde	Summer SH Smolts
Dayton Pond	22	Touchet	Summer SH Smolts

SH - Steel head
CT = Cutthroat

Objective 1.0 Complete Start-up Phase

Task 1.1 - Acquire Competent Staff

The project leader expended considerable effort in the search for competent staff to perform the tasks requiring fish health expertise. While going through the hoops normally required by our agency and the Department of Personnel to fill new positions, it became clear that we would not have new staff hired as soon as we had expected. Fortunately, one very competent person was already on our pathology staff to get the ball rolling at some of our facilities and to begin ordering equipment.

The WDW was going through a difficult time financially at the time we were attempting to fill our fish health monitoring positions. The agency administration insisted that we fill the vacancies with present personnel if at all possible as we were anticipating an agency-wide reduction in force of considerable magnitude. As it turned out, Bruce Bolding, a very competent biologist with considerable experience in the technical aspects of fish health was temporarily employed by our agency doing our virology in the Department of Fisheries' laboratory. We were able to place him in our laboratory position.

The fish pathologist register provided to us contained the name of another agency employee with fish health training. Don Chase has transferred to the project from his former position where he was primarily involved in optimization of hatcheries through the use of computers. He brings with him expertise in computer use and programming as well as experience in fish culture and training in fish pathology. He has fit into the project very well.

Our needs also include a part-time position to assist with laboratory work. We have had the good fortune to hire Jennifer Hulett for two months this year to help us catch up our lab work.

Our team includes:

Jim Gearheard, Hatchery Program Manager & Project Leader - 1/6 time

Steve Roberts, Fish Pathologist 3: Lead pathologist covering Snake River and Columbia River hatcheries above the Snake-Columbia confluence - 1/2 time

Don Chase, Fish Pathologist 2: Lead data manager and pathologist for Lower Columbia hatcheries - 1/2 time

Bruce Bolding, Wildlife Biologist 2: Lead laboratory biologist and field assistant - Full time

Jennifer Hulett, Wildlife Biologist 1: Laboratory assistant - 1/6 time

Objective 2.0 Technical Steering Committee

Task 2.1

Two meetings of the Project Technical Steering Committee were held. The first was held at Idaho Fish and Game office, Boise, Idaho on March 4, 1987. Jim Gearheard, project leader along with Steve Roberts, fish pathologist attended the meeting. The second was held at U.S. Fish and Wildlife Service, Fish Culture Development Center, Bozeman, Montana on June 22, 1987. Steve Roberts attended the second meeting. At both meetings current project progress as well as an interpretation and modifications of project tasks were addressed.

A. Quarterly meetings:

The project leader and lead pathologist attended a quarterly meeting in March in Boise, Idaho.

The lead pathologist, lead data manager and lead laboratory biologist attended the June quarterly meeting in Bozeman, Montana.

B. Monthly reports:

Monthly reports, briefly outlining sampling and findings of interest, problems and deviations, planned activities, and major purchases of equipment have been provided to BPA.

c. Hatchery Manager, Project Staff meeting:

A meeting of all involved WDW personnel was held in April at the Mossyrock hatchery to insure all persons would participate in the project productively. More coordination meetings with WDW staff will be held in the future.

D. Communication - Other:

The lead pathologist presented a talk on the project to all WDW fishery biologists at their annual meeting in May. The project leader has communicated on a regular basis with regard to the project at Olympia division staff meetings and statewide program managers' meetings.

The lead pathologist made a presentation at the Western Fish Disease Conference held in June in Bozeman, Montana.

Task 2.2 Technology Transfer

WDW will develop for BPA approval, a plan to accomplish technology transfer and efficient communications between personnel in fisheries management, hatcheries, and research. This plan will include coordination and consultation with the Council, Columbia basin's agencies and Tribes on the Fish and Wildlife Program and Regional Act, as well as such other technical subjects as may be deemed necessary i.e. data collection and report generation.

Task 2.3 Facility Impediments

Below is a table of facility impediments to fish health for each facility. A list of expected benefits and cost will be developed later.

Table 2. Table of Impediments to Fish Culture - Columbia Basin Hatcheries

Hatchery	Water Supply						Facilities		Totals
	Low Flow	Temp Var.	Org. Load	Path. Load	Open Sprs.	Surface Water	R/R R. U.	Reuse Water	
Beaver Creek	X	X	X	X		X			5
Chelan	X			X	X	X		X	5
Columbia Basin	X		X		X				3
Cowlitz	X	X	X	X		X		X	6
Lyons Ferry									0
Naches	X		X	X	X	X	X	X	7
Ringold			X		X				2
Skamania	X	X	X	X		X	X		6
Tucannon		X		X		X			3
Vancouver	X				X		X	X	4
Wells				X		X			2
Yakima	X		X	X	X	X	X	X	7
Totals 12	a	4	7	a	6	a	4	5	a

R/R R. U. **Repair and/or renovate rearing units.**

Objective 3.0 Fish Health Monitoring

Task 3.1 Organosomatic analysis "index" hatcheries.

Organosomatic analysis of fish species was done at two "approved" index hatcheries, Cowlitz Hatchery on the Cowlitz River and Wells Hatchery on Columbia River. Organosomatic index analysis was developed by Goede (1966). The organosomatic analysis involves a "qualitative" classification of individual fish. Parts of the fish are "scored" against what is "normal", i.e. amount of fin erosion, fat content, kidney condition, etc. Hematocrit, length, weight, and condition are also measured and compared against other fish sampled. Sixty (60) fish are sampled, scored and summarized as a reflection of the total population. The results from the "organosomatic analysis" can be used to estimate fish "quality" - both esthetically and fish health-wise. This in turn may help to determine if increased organosomatic quality can be related to increased fishery returns, i.e. hatchery survival.

Goede developed a Lotus 123 template allowing easy data entry, data analysis, and summary, but it was not available at the time the organosomatic analyses were performed at the hatcheries. Therefore, a Lotus 123 data entry and analysis program was developed for the interim. Goede's "Organosomatic Analysis" Lotus 123 template will be used for next year's organosomatic analysis.

Sixty (60) fish from each stock (lot) were randomly sampled and sacrificed on site for organosomatic analysis. The following items were evaluated and scored:

Scales	- Location and percent of descaling
Eyes	- Normal, Exothalmia, Hemorrhagic, Blind, Cataracts, Missing
Fins	- Percent of fin erosion
Gills	- Normal, Frayed, Clubbed, Marginate, Pale
Pseudobranchs	- Normal, Swollen, Lithic, Swollen & Lithic, Inflamed, Pale
Thymus	- Normal, Mild hemorrhage, Severe hemorrhage
Fat	- percent of pyloric caecum covered
Sex	- Male, Female, Precocious male
Spleen	- Normal, Granular, Enlarged, Nodular, BKD lesions present
Hind Gut	- Normal, Mild inflammation, Severe Inflammation
Kidney	- Normal, Pale, Swollen, Granular, Percent urolithiasis, BKD lesions present
Liver	- Normal, Pale, Gen. discoloration, Focal discoloration, Fatty, Nodular, BKD lesions present

- Mesentery** - Normal, Mild inflammation, Severe inflammation.
- Hematocrit** - Volume of red blood cells expressed as percent of total blood volume.

The following table shows hatchery location, species and stocks sampled.

Table 3. List of hatcheries, species and stocks in which an organosomatic analysis was performed.

Hatchery	Species	Stock
Cowlitz	Cutthroat	Cowlitz
Cowlitz	Winter steelhead	Cowlitz
Cowlitz	Late winter sthd	Cowlitz
Cowlitz	Summer steelhead	Cowlitz
Well Is	Summer steelhead	Well Is

Results of organosomatic analysis

Table 4. Organosomatic analysis of “measured” Items, length, weight, condition, hematocrit (Hc) for each species.

Hatchery	Spp.	Mean Length	SD	Mean Wt.	SD	K-Factor	Hc	SD
Cowlitz	CT	209.5	24.0	94.5	35.3	1.03	44.4	5.4
Cowlitz	SW	211.5	16.2	93.8	22.7	0.99	42.1	5.0
Cowlitz	LSW	189.0	17.5	78.4	22.4	1.16	44.8	5.2
Cowlitz/ Well Is	ss	204.5	32.4	75.6	21.9	0.88	50.4	6.5

Table 5. Organosomatic analysis of "scored" items, fat, spleen, hind gut, kidney, and liver for each species.

Item	Min. Score	Max. Score
Fat	0	4
Spleen	0	5
Hind Gut	0	2
K I dney	0	6
Liver	0	6

0 = "Normal "

Hat.	SPP .	Mean		Mean		Mean		Mean		Mean	
		Fat	SD	Spln	SD	H Gut	SD	Kdny	SD	Lvr	SD
Cow.	CT	3.0	1.5	0.7	1.2	0.1	0.3	3.3	1.3	0.2	0.7
cow.	SW	1.2	0.9	0.7	0.7	0.4	0.6	3.4	1.2	0.0	0
cow.	LSW	2.6	1.2	0.3	0.4	0.3	0.5	1.0	0.0	0.0	0
cow. /											
Wells	SS	1.2	0.5	0.8	0.0	0.2	0.0	1.8	0.0	0.0	0

Table 6. Percent of population scoring “abnormal” for each stock/species.

Cutthroat - Cowlitz Hatchery.

Score	Fat	Spleen	Hind Gut	Kidney	Liver
0	11.7%	70.0%	91.7%	3.3%	90.0%
1	10.0%	10.0%	8.3%	18.3%	6.7%
2	6.7%	0.0%	0.0%	0.0%	0.0%
3	15.0%	20.0%		0.0%	1.7%
4	56.7%	0.0%		78.3%	1.7%
5		0.0%		0.0%	0.0%
6				0.0%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

Winter Steelhead - Cowlitz Hatchery.

Score	Fat	Spleen	Hind Gut	Kidney	Liver
0	20.0%	45.0%	61.7%	0.0%	100.0%
1	51.7%	50.0%	35.0%	20.0%	0.0%
2	20.0%	0.0%	3.3%	0.0%	0.0%
3	8.3%	0.0%		0.0%	0.0%
4	0.0%	5.0%		80.0%	0.0%
5		0.0%		0.0%	0.0%
6				0.0%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

Late Winter Steelhead - Cowlitz Hatchery.

Score	Fat	Spleen	Hind Gut	Kidney	Liver
0	6.7%	75.0%	80.0%	0.0%	95.0%
1	3.3%	25.0%	16.7%	100.0%	5.0%
2	15.0%	0.0%	3.3%	0.0%	0.0%
3	25.0%	0.0%		0.0%	0.0%
4	50.0%	5.0%		80.0%	0.0%
5		0.0%		0.0%	0.0%
6				0.0%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

Table 6. Summer Steelhead - Cowlitz & Wells Hatchery.

Score	Fat	Spleen	Hind Gut	Kidney	Liver
0	20.8%	27.5%	70.8%	0.0%	94.2%
1	44.3%	71.7%	25.8%	60.8%	5.8%
2	25.8%	0.0%	3.4%	0.0%	0.0%
3	8.3%	0.8%		0.8%	0.0%
4	0.8%	0.0%		35.8%	0.0%
5		0.0%		2.5%	0.0%
6				0.0%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

Discussion of organosomatic analysis

The organosomatic analysis is an efficient method of evaluating fish quality or assessing deviations from the norm. The above data clearly show that the kidneys of anadromous fish (CT, SW, LSW, SS) are abnormal. Further investigation showed that these fish are suffering from an infection of Ceratomyxa Shasta. However, as far as using the organosomatic analysis to determine fish survival more data and study is necessary. Continuation of using the organosomatic analysis in next year's study will further understanding of "fish quality".

Task 3.2 Test for Specific Pathogens

Standard techniques were employed for the analysis of all samples collected for the project. Cell culture technique, according to the American Fisheries Society (AFS) Fish Health Blue Book was used for all viral assays for IHNV and IPNV. Viral assays were performed by Washington Department of Fisheries (WDF) virology lab under a joint contract between WDW and WDF. For EIBS, Leishman-Giemsa stained blood smears were examined with a light microscope at 1000X for three minutes each, or until cytoplasmic inclusion bodies were found.

Analysis for Myxobolus cerebralis was by the AFS Blue Book plankton centrifuge technique, with microscopic examination of wet mounts at 400X magnification. Analysis for Ceratomyxa Shasta consisted of microscopic observation of wet mounts of scrapings of the descending intestine at 400X magnification. At the pathologists' discretion, there was no need to examine any lot of fish for PKD.

Examination and laboratory analysis for bacterial pathogens was not carried out according to contractual agreements due to delays in acquiring proper equipment and facilities. Samples were collected, however, from all lots of fish, for the FAT analysis for BKD. The proper equipment was acquired and processing of the samples is currently underway.

Table 7. Broodstock Monitoring: Viral Diseases

<u>Hatchery</u>	<u>Date</u>	<u>Species</u>	<u>Stock</u>	<u>IHN</u>	<u>IPNV</u>	<u>EIBS - %</u>
Beaver Cr	1286-0287	W Steelhead	Beaver Cr.	neg	neg	18/60=30% pos
Beaver Cr	1286-0187	SR Cutthroat	Beaver Cr.	neg	neg	2/60- 3% pos
Chelan	1286-0187	S. Steelhead	Ringold	neg	neg	47/60=78% pos
Cowlitz	1286-0187	S. Steelhead	Cowlitz	neg	neg	11/60=18% pos
Cowlitz	0387	W Steelhead	Cowlitz	pos	neg	25/60- 42% pos
Cowlitz	1286-0187	W Steelhead(late)	Cowlitz	pos	neg	NS
Cowlitz	0587	SR Cutthroat	Cowlitz	neg	neg	59/60=98% pos
Lyons Ferry	0287-0387	S. Steelhead	Lyons F.	pos	neg	35/60=58% pos
Skamania	1286-0387	S. Steelhead	Skamania	pos	neg	28/60=47% pos
Skamania	1286-0387	W Steelhead	Skamania	neg	neg	22/60- 37% pos
Skamania	1286-0187	SR Cutthroat	Skamania	neg	neg	NS
Wells	1286-0287	S. Steelhead	Wells	neg	neg	54/60- 90% pos
Yakima	0187-0487	S. Steelhead	Yakima	neg	neg	7/30=23% pos

NS - Not Sampled

Table 8. Juvenile Monitoring (Smolt Preliberation): Viral Diseases

<u>Hatchery</u>	<u>Date</u>	<u>Species</u>	<u>Stock</u>	<u>IHN</u>	<u>IPNV</u>	<u>EIBS - %</u>
Alder Cr. Pond		S. Steelhead	Skamania	neg	neg	N/C
Beaver Cr.		S. Steelhead	Beaver Cr.	neg	neg	15/60=25% pos
Beaver Cr.		W Steelhead	Beaver Cr.	neg	neg	34/60=56% pos
Beaver Cr.		SR Cutthroat	Beaver Cr.	neg	neg	15/60=25% pos
Chelan		S. Steelhead	Wells	neg	neg	27/60=45% pos
Cottonwood Pond		S. Steelhead	Wallowa	neg	neg	21/60=35% pos
Coweeman Pond		W Steelhead	Beaver Cr.	neg	neg	16/60=27% pos
Coweeman Pond		SR Cutthroat	Beaver Cr.	neg	neg	13/31=42% pos
Cowlitz		S. Steelhead	Cowlitz	neg	neg	30/60=50% pos
Cowlitz		W Steelhead	Cowlitz	neg	neg	29/30=97% pos
Cowlitz		SR Cutthroat	Cowlitz	neg	neg	19/60=32% pos
Cur I Lake		S. Steelhead	Lyons F.	neg	neg	10/60=17% pos
Dayton Pond		S. Steelhead	Wells	neg	neg	19/60=32% pos
Gobar Pond		S/W Steelhead	Skamania	pos	neg	21/59=36% pos
Lyons Ferry		S. Steelhead	Lyons F.	neg	neg	30/60=50% pos
Lyons Ferry		S. Steelhead	Wallowa	neg	neg	25/60=42% pos
Lyons Ferry		S. Steelhead	Wells	neg	neg	24/60=40% pos
Merwin Net Pen		S. Steelhead	Skamania	neg	neg	2/30=7% pos
Nelson Springs		S. Steelhead	Yakima	neg	neg	16/60=27% pos
Ringold		S. Steelhead	Ringold	neg	neg	13/60=22% pos
Skamania		S. Steelhead	Skamania	pos	neg	13/60=22% pos
Skamania		W Steelhead	Skamania	neg	neg	17/60=28% pos
Skamania		SR Cutthroat	Skamania	neg	neg	17/52=33% pos
So. Toutle Trap		S. Steelhead	Skamania	neg	neg	24/60=40% pos
Turtle Rock		S. Steelhead	Ringold	neg	neg	33/60=55% pos
Vancouver		S. Steelhead	Skamania	neg	neg	14/60=23% pos
Wells		S. Steelhead	Wells	neg	neg	25/60=42% pos
Yakima		S. Steelhead	Yakima	neg	neg	10/60=17% pos

Table 9. Juvenile Monitoring: Parasitic Diseases

<u>Hatchery</u>	<u>Date</u>	<u>Species</u>	<u>Stock</u>	<u>M. cerebralis</u>	<u>C. shasta</u>	<u>PKD</u>
Beaver Cr.	012187	W Steelhead	Beaver Cr.	neg	NS	NS
Curl Lake	042887	S. Steelhead	Lyons Ferry	neg	NS	NS
Nelson Sp.	011287	S. Steelhead	Yakima	neg	NS	NS
Skamania	012887	S. Steelhead	Skamania	neg	neg	NS
Skamania	0687	W Steelhead	Skamania	NS	neg	NS
Skamania	0687	SR Cutthroat	Mixed	NS	neg	NS
Turtle Rock	013067	S. Steelhead	Ringold	neg	NS	NS
Vancouver	0687	S. Steelhead	Skamania	NS	neg	NS
Wells	012187	S. Steelhead	Wells	neg	NS	NS

NS - Not Sampled

Table 10. Broodstock Monitoring: Bacterial Kidney Disease

<u>Hatchery</u>	<u>Date</u>	<u>Species</u>	<u>Stock</u>	<u>Results</u>
Chelan	01/13/87	S Steelhead	Ringold	0/60 = 0% pos
Cowlitz	12/18/86	SR Cutthroat	Cowlitz	2/60 = 3% pos
Cowlitz	01/06/87	W Steelhead	Cowlitz	0/60 = 0% pos
Lyons Ferry	02/24 - 03/01/87	S Steelhead		2/60 = 3% pos
Wells	02/04/87	S Steelhead	Wells	1/60 = 1.5% pos

Table 11. Juvenile Monitoring (Smolt Preliberation): Bacterial Kidney Disease

<u>Hatchery</u>	<u>Date</u>	<u>Species</u>	<u>Stock</u>	<u>Results</u>
Alder Cr Pd	05/04/87	S Steelhead	Skamania	2/60 = 3% pos
Cottonwood Pd	04/21/87	S Steelhead	Walla	2/60 = 3% pos
Coweeman Pd	04/23/87	SR Cutthroat	Beaver Creek	10/30 = 33% pos
Coweeman Pd	04/23/87	W Steelhead	Beaver Creek	6/30 = 20% pos
Lyons Ferry	04/14/87	S Steelhead	Lyons Ferry	0/60 = 0% pos
Lyons Ferry	04/14/87	S Steelhead	Wells	0/60 = 0% pos
Nelson Sp	03/31/87	S Steelhead	Yakima	0/60 = 0% pos
Ringold	04/13/87	S Steelhead	Ringold	0/60 = 0% pos
Wells	04/27/87	S Steelhead	Wells	0/60 = 0% pos
Yakima	03/31/87	S Steelhead	Yakima	0/60 = 0% pos

Objective 4.0 Monitoring Hatchery Water Supplies

Task 4.1 Sample hatchery water supplies:

A water sampling plan was developed for WDW hatcheries and rearing facilities participating in the "Augmented Fish Health Monitoring Project". This sampling plan found in the table below:

Table 12. Listing of locations, water supplies and water sampling dates.

Hatchery Location	Water Supply	Sample Date
Alder Cr. Pond	Alder Cr.	April
Beaver Cr.	Beaver Cr.	April, October
	Well source	January
	Elochoman River	July
Chelan	Well source	April, October
	Spring source	April, October
Columbia Basin	Spring	August
Cottonwood Pond	Cottonwood Cr.	April
Coweeman CT Pd	Creek	April
Coweeman SW Pd	Creek	April
Cowlitz	Well source	April, October
	Cowlitz	July
Curl Lake	Tucannon River	April
Dayton Pond	Touchet River	April
Gobar Pond	Gobar Cr.	April
Lyons Ferry	(sampled per WDF contract)	
Merwin Net Pen	Merwin Res.	April
Naches	Seep system	May, November
Naches River	June	
Nelson Springs	Spring	April
Ringold Springs	(sampled per WDF contract)	
Skamania	Skamania River	April, October
Vogel Cr.	January	
S. Toutle Trap	Creek	April
Turtle Rock	(sampled per WDF contract)	
Vancouver	Spring	April, October
Keffel Lake	January	
Wells	(sampled per WDF contract)	
Yakima	Spring	April, November
Spring Cr.	April	

Daily temperatures and monthly water flows have been recorded as per the BPA contract. However, dissolved oxygen and pH have only been partially recorded, since a dissolved oxygen and pH meter only exist for eastside BPA project hatcheries.

A BPA contractor will perform measurements on the following items: hardness, alkalinity, nitrate, nitrite, total ammonia, settleable solids, suspended solids, dissolved solids, iron,

manganese, lead, mercury, zinc, cadmium, chromium, copper, PCB, organophosphates, total dissolved gas, and total nitrogen gas.

Task 4.2 Monitor flow and loading densities for each lot of fish:

Flow Loading Index (FLI) and Maximum Density Index (MDI) carrying capacity calculations have not been calculated for all BPA project facilities. This lack occurred because of delays in designing production reporting forms to monitor fish production.

The Maximum Density Index (MDI) was developed by Piper (1972). The model is described as follows:

$$W = D * V * L$$

where, W - permissible weight (biomass) of fish,
D - density index for species (proportion of fish length and fish weight per cubic feet of rearing space)

0.50 - rainbow trout
0.26 - steelhead (winter & summer)
0.30 - chinook and coho
0.35 - brown and brook trout
0.33 - cutthroat (anadromous & resident)

V - cubic feet of rearing space,
L - length of fish in inches.

The above model follows the principle that "as fish size increases, fish loading can be increased proportionally". Studies done by Piper (1972) show there was no effect on rate of growth or food conversion as fish density increased from 1.0 to 5.6 pounds per cubic foot. As a "rule of thumb" to avoid undue crowding, Piper further suggested that trout should be held at densities equal to one-half their length, i.e. 2-inch fish at 1 pound per cubic foot, 4-inch fish at 2 pounds per cubic foot, etc. Klontz (pers. comm) further studied the density index concept for different species of fish and produced species specific density indexes that are conducive to optimum fish health.

The second carrying capacity model used is the "Flow Loading Index" (FLI) method (Piper, 1972). This model is described as follows:

$$W = F * L * I$$

where, W - permissible weight (biomass) of fish,
F - Flow index (biomass of fish/gpm/length of fish) related to water temperature and elevation (a table of flow indexes can be found on page 69 in Fish Hatchery Management by Piper, 1972)
I - water inflow in gallons per minute,
L - length of fish in inches.

The flow index method of calculating carrying capacity assumes that water inflow or more specifically, oxygen availability is the limiting factor. The FLI model assumes that the oxygen levels are at 100% of saturation and the minimum outflow oxygen is 5.0 ppm. Therefore, FLI should be used as a guide for planning and estimating carrying capacity, and if possible specific flow indexes should be developed for each hatchery.

The MDI method assumes that carrying capacity is limited by the density requirements of the fish, no consideration is given to the environmental requirements, i.e. oxygen or accumulation of metabolic wastes. Ideally then, one could raise one pound of 2-inch rainbow trout in a 1 cubic foot tank without any water exchange - of course this is unrealistic. However, FLI does not consider the density requirements. For example: a tank with 10 gpm inflow and a one cubic foot tank could (theoretically) rear 1.8 pounds of trout. Which is correct? The resulting debate is beyond the scope of this report, but is identified that each model has a weakness and consequently both models should be calculated. The carrying capacity recommendations by Piper are that pond loadings should not exceed the lower of the two carrying capacity models.

Pond loadings are expressed as a percent of carrying capacity, which is simply the total biomass divided by the permissible biomass calculated by MDI or FLI. This number is much easier to understand how much above or below pond loading is as related to carrying capacity. For example, a biomass of a pond is 800 pounds and the permissible loading as calculated by MDI is: 1,000 pounds. and FLI is: 790 pounds. Therefore, you are 80% of carrying capacity according to MDI, and 101% of carrying capacity according to FLI.

Percent of carrying capacities for several hatcheries (Beaver Cr., Cowlitz, Skamania, Vancouver) were assimilated into mean percent carrying capacities per month. This data is presented in the table below:

Table 13. Mean percent of carrying capacities for several hatcheries (Beaver Cr., Cowlitz, Skamania, Vancouver).

Month	Mean MDI	SD	Mean FLI	SD
February	43.5%	33.3	55.4%	14.1
March	46.2%	30.2	65.1%	30.4
April	44.3%	29.0	62.5%	32.1
May	48.6%	29.3	86.5%	49.9

Education of hatchery staffs in the methodology of MDI and FLI carrying capacity models is an important task.

Objective 5.0 Record, analyze, report fish health monitoring and related data.

Upon receipt of hardware and software, a database recording monthly hatchery production data and fish health monitoring data was developed. The system is designed that the production or fish health information can be easily retrieved, sorted and exported to Lotus 123 for additional statistical analysis and/or gleaned for summary information.

Currently the monthly hatchery production database contains over 600 records of production information. The data is obtained from the hatcheries either written on a production monitoring form or if a microcomputer is available on disk in Lotus 123 format. In either case, the production data is entered into the computer via Lotus 123 spreadsheet software. This enables immediate data transformations, summaries, and/or statistical analysis. After review/manipulation the data is "imported" into dBase III+ hatchery production database. Once in this database, data can be selected for by a variety of criteria and exported into 123 for further analysis.

Current analysis of hatchery production data has consisted of monitoring pond loading rates, and mortalities associated with disease episodes. Future data analysis will consist of continued monitoring of pond loading rates, and analysis of growth rates and food conversions.

Data is entered directly into the fish health database via dBase III+. Again, data can be selected for, and retrieved with relative ease.

An effort is being made to equip many of our major hatchery facilities with microcomputers so that hatchery staffs can perform data entry, data transformations, and statistics about their own fish production. In this way they can learn more about their fish and consequently be better managers of their hatchery programs.

Objective 6.0 Estimate the Project's Benefits

Task 6.1 Report Existing Data: 1983 to 1986.

Task. 6.1.1 Severity of Pathogens and Mortality Caused

IHN had been isolated from adult fish at Cowlitz hatchery in 1981 and 1982. The IHN incidence at each hatchery was varied substantially from 1983 to 1985. Results of adult sampling for 1983 to 1986 are seen in Table 14.

Table 14. Incidence of IHN in adult fish at WDG Columbia River hatcheries.

Facility	Species	No. Positive/ No. Sampled (% Positive)			
		1983	1984	1985	1986
Beaver Crk	CT	0/312 (0%)	0/202 (0%)	0/227 (0%)	0/250 (0%)
	SW	0/359 (0%)	0/467 (0%)	1/283 (1%)	0/367 (0%)
Chelan	SS	NF	NF	NF	0/265 (0%)
Cowlitz	CT	0/546 (0%)	0/403 (0%)	0/348 (0%)	0/389 (0%)
	SS	0/285 (0%)	0/161 (0%)	0/130 (0%)	0/110 (0%)
	SW	0/386 (0%)	0/395 (0%)	0/422 (0%)	0/296 (0%)
Lyons Ferry	SS	0/13 (0%)	NF	NF	0/248 (0%)
Skamania	ss	152/461 (33%)	0/392 (0%)	0/1170 (0%)	0/505 (0%)
	SW	54/55 (98%)	0/133 (0%)	0/1 (0%)	0/47 (0%)
Wells	ss	0/411 (0%)	0/414 (0%)	0/366 (0%)	0/353 (0%)
Yakima	ss	0/362 (0%)	0/63 (0%)	0/380 (0%)	0/73 (0%)

NF = No adult broodfish held and spawned

CT = Cutthroat

ss = Summer Steelhead

SW = Winter Steelhead

IPN has been isolated from adult summer steelhead from Tucannon and Wells hatcheries. Since 1983 the IPN isolations have been limited to adult steelhead at Wells hatchery. The incidence at Wells has been less than 1 percent of the adult fish sampled. Sampling in the past for IPN has been limited to spawning adults. Results are shown in Table 15.

Table 15. Incidence of IPN in adult fish at WDG Columbia River hatcheries.

Facility	Species	No. Positive/ No. Sampled (% Positive)			
		1983	1984	Year 1985	1986
Beaver Crk	CT	0/60 (0%)	NS	0/61 (0%)	NS
	SW	0/60 (0%)	NS	0/114 (0%)	0/60 (0%)
Chelan	ss	NF	NF	NF	0/265 (0%)
Cowlitz	CT	NS	NS	NS	0/55 (0%)
	ss	NS	NS	0/46 (0%)	0/54 (0%)
	SW	NS	NS	0/72 (0%)	0/45 (0%)
Lyons Ferry	ss	0/26 (0%)	NF	NF	0/81 (0%)
Skamania	ss	0/70 (0%)	0/60 (0%)	NS	0/505 (0%)
	SW	NS (0%)	0/60 (0%)	NS	0/47 (0%)
Wells	ss	3/411 (<1%)	1/414 (<1%)	0/366 (0%)	0/353 (0%)
Yakima	ss	0/362 (0%)	0/63 (0%)	0/380 (0%)	0/73 (0%)

NF = No adult broodfish held and spawned

NS = No sample collected

CT = Cutthroat

ss = Summer Steelhead

SW = Winter Steelhead

No systematic sampling for EIBS had been done at any VDW facility in either adults or juveniles for 1983 to 1986.

Bacterial Pathogens:

No systematic sampling for any bacterial pathogen had been done at any VDW facility in either adults or juveniles for 1983 to 1986. Identification of bacterial pathogens has been limited to diagnostic cases.

Parasites:

Sampling for the whirling disease agent has been very sporadic at VDW facilities in past years. Only one sample was collected from summer steelhead from Lyons Ferry hatchery April, 1985. The results were negative (Table 16).

Hatchery	Date	Species	Stock	Sample	Result
Lyons Ferry	4/85	ss	Wallowa	60	Neg.

ss - Summer steelhead

Routine sampling for Ceratomyxa Shasta and the PKX organism has not been done in the past at any VDW hatcheries. Ceratomyxosis has continued to plague operation at the Cowlitz hatchery.

Task 6.1.2 Total Number and Percent Loss of Each Lifestage of Fish Species

Lot production mortalities

Lot production data from VDW hatchery reports were entered into a Lotus 1-2-3 worksheet. Calculations were made that includes total number and percentage loss for each facility. Work has been completed for all eastern Washington hatcheries except Lyons Ferry for 1983 to 1985 broodyears.

Chelan

At Chelan hatchery from 1983 to 1985 the average eyed to hatch egg mortality for Wells stock summer steelhead has been 5.4 %. The average fry to smolt mortality has been 8.6 %. Summer steelhead at Chelan have average 13.5% total mortality from eyed egg to smolt stage. A summary of the egg and fry mortality for summer steelhead reared at Chelan is shown in Table 17.

Table 17. A summary of egg and fry mortality for Chelan.

Hatchery: Chelan

Species: Summer Steelhead Stock : Wells

Brood Year	Starting No.	Egg Mortality No. %	Fry Mortality No. %	Total No.	Mortality %
1983	254,760	25,758 1/ 10.1	18,554 8.1	44,312	17.4
1984	249,920	6,048 1/ 2.4	19,340 7.9	25,388	10.2
1985	247,643	8,733 1/ 3.5	23,044 9.6	31,777	12.8
Avg.	250,774	13,513 5.4	20,313 8.6	33,826	13.5

Note: 1/ Egg loss only includes eyed to hatch.

Chelan - Turtle Rock

The Ringold stock summer steelhead are also reared at Chelan hatchery until November of each year; then the fish are transfer to Turtle Rock rearing pond for final rearing. Ringold stock summer steelhead broodyears 1983 and 1985 were reared at Chelan - Turtle Rock with Skamania stock summer steelhead reared in 1984-85. At Chelan hatchery from 1983 to 1985 the average eyed to hatch egg mortality for Ringold stock summer steelhead has been 12.6 %. The average fry to smolt mortality has been 29.0 %. Summer steelhead at Chelan - Turtle Rock has average 35.3% total mortality from eyed egg to smolt stage. A summary of the egg and fry mortality for summer steelhead reared at Chelan - Turtle Rock is shown In Table 18.

**Table 18. A summary of egg and fry mortality for Chelan
- Turtle Rock.**

Hatchery: Chelan - Turtle Rock
Species: S. Steelhead

Brood Year	Starting No.	Egg Mortality No. %	Fry Mortality No. %	Total No.	Mortality %
1983	264,192	49,226 2/ 18.6	57,471 26.7	106,697	40.4
1984 1/			53,061 38.7	53,061	38.7
1985	250,155	16,676 2/ 6.7	50,624 21.7	67,300	26.9
Avg.	257,174	32,951 12.6	53,719 29.0	75,686	35.3

Notes: 1/ In 1984 the fish were received as fry from Vancouver hatchery.
2/ Egg loss only includes eyed to hatch.

Naches - Nelson Springs

Summer steelhead are incubated and reared at Naches hatchery and then transferred to Nelson Springs for final rearing. Ringold stock summer steelhead were reared in 1983-84 and 1985-86 with Wells stock summer steelhead reared in 1984-85. At Naches hatchery from 1983 to 1985 the average eyed to hatch egg mortality for Ringold / Wells stock summer steelhead has been 7.4 %. The average fry to smolt mortality has been 27.9 %. Summer steelhead at Naches - Nelson Springs has averaged 33.3 % total mortality from eyed egg to smolt stage. A summary of the egg and fry mortality for summer steelhead reared at Naches - Nelson Springs is shown in Table 19.

Table 19. A summary of egg and fry mortality for Naches - Nelson Springs.

Hatchery: Naches - Nelson Springs

Species: Summer Steelhead Stock : Ringold / Wells

Brood Year	Starting No.	Egg Mortality No. %	Fry Mortality No. %	Total No.	Mortality %
1983	185,760	17,360 1/ 9.3	38,252 22.7	55,612	29.9
1984	131,328	5,328 1/ 4.1	7,939 6.3	13,267	10.1
1985	160,344	12,852 1/ 8.0	77,079 52.3	89,931	56.1
Avg.	159,144	11,847 7.4	41,090 27.9	52,937	33.3

Note: 1/ Egg loss only includes eyed to hatch.

Wells

At Wells hatchery from 1983 to 1985 the average green to hatch egg mortality for Wells stock summer steelhead has been 17.0 %. The average fry to smolt mortality has been 2.9 %. Summer steelhead at Wells have average 18.4% total mortality from green egg to smolt stage. A summary of the egg and fry mortality for summer steelhead reared at Wells is shown in Table 20.

Table 20. A summary of egg and fry mortality for Wells.

Hatchery: Wells

Species: Summer Steelhead Stock : Wells

Brood Year	Starting No.	Egg Mortality No.	%	Fry Mortality No.	%	Total No.	Mortality %
1983	2, 248, 025	581, 795	1/2/ 25.9	20, 175	2.1	601, 970	26.8
1984	1, 801, 233	170, 000	1/3/ 9.4	19 266	2.2	189, 266	10.5
1985	2, 234, 560	349, 400	1/ 15.6	50, 000	4.3	399, 400	17.9
Avg.	2, 094, 606	367, 065	17.0	29, 814	2.9	396, 879	18.4

Notes: 1/ Egg loss from green to hatch
 2/ Includes 292,000 egg destroyed because of IPN
 3/ Includes 24,700 egg destroyed because of IPN

Yakima - Columbia Basin - Ringold

Summer steelhead are incubated and initially reared at Yakima hatchery. The fish are then transferred to Columbia Basin hatchery and finally to Ringold rearing pond for final rearing to smolts. Ringold stock summer steelhead were reared for all three years. At Yakima the average egg mortality for green to hatch was 26.0 %. The average fry mortality which occurred at all three facilities was 14.3 % with the average overall mortality of 36.6 %. A summary of the egg and fry mortality for summer steelhead reared at Yakima - Columbia Basin - Ringold is shown in Table 21.

Table 21. A summary of egg and fry mortality for Yakima Hatchery.

Hatchery: Yakima - Columbia Basin - Ringold
Species: Summer Steelhead Stock : Ringold

Brood Year	Starting No.	Egg No.	Mortality %	Fry No.	Mortality %	Total No.	Mortality %
1983	701,760	331,768	1/ 47.3	88,906	24.0	420,674	59.9
1984	276,602	68,100	1/ 24.6	46,058	22.1	114,158	41.3
1985	1,469,930	235,720	1/ 16.0	124,583	10.1	360,303	24.5
Avg.	816,097	211,863	26.0	86,516	14.3	298,378	36.6

Note: 1/ Egg loss from green to hatch

Adult Prespawning Mortalities

Adult prespawning mortality data from VDW hatchery reports were entered into a Lotus 123 worksheet. Calculations were made that includes total number and percentage loss for each broodstock hatchery. Work has been completed for all eastern Washington hatcheries for 1983 to 1985.

Ringold summer steelhead broodstock

Returning summer steelhead are trapped at Ringold rearing pond during late summer and early fall. In 1983 and 1984, the fish were transported to the Yakima hatchery for maturation and spawning. In 1985, the fish were transported to Chelan for maturation and spawning. The average total prespawning mortality for the adult steelhead was 8.4 % for the five to six months holding period.

Table 22. A summary of adult mortality for Yakima - Chelan hatcheries.

Hatchery: Yakima - Chelan

Species: Summer steelhead

Broodstock: Ringold

Year	No. Trapped	Mortality No.	%	Average Monthly % Mortality
1983 1/	138	24	17.4	4.2
1984 1/	606	6	1.0	0.3
1985 2/	544	37	6.8	1.8
Avg.	429	22	8.4	2.1

Notes: 1/ Fish were held and spawned at Yakima.
2/ Fish were held and spawned at Chelan.

Wells summer steelhead broodstock

Returning summer steelhead are trapped at west bank fish ladder at Wells dam during late summer and early fall. The average total prespawning mortality for the adult steelhead was 8.4 % for the five to six months holding period.

Table 23. A summary of adult mortality for Wells Hatchery.

Hatchery: Wells

Species: Summer steelhead

Broodstock: Wells

Year	No. Trapped	Mortality No.	%	Average Monthly % Mortality
1983	673	4	0.6	0.1
1984	690	6	0.9	0.2
1985	750	3	0.4	0.1
Avg.	704	4	0.6	0.1

Yakima summer steelhead broodstock

Returning summer steelhead are trapped at Prosser dam and transported to Yakima during late summer and early fall. The average total prespawning mortality for the adult steelhead was 16.9 % for the five to six months holding period.

Table 24. A summary of adult mortality for Yakima Hatchery.

Hatchery: Yakima

Species: Summer steelhead

Broodstock: Yakima

Year	No. Trapped	Mortality		Average Monthly % Mortality
		No.	%	
1985	130	22	16.9	7.1

Task 6.1.3 Number and Causative Agents of Epizootics, Type and Amount of Medication Used

WDW fish pathology reports (Brunson and Roberts, 1983; Brunson and Roberts, 1984; Brunson and Roberts, 1985; and Brunson and Roberts, 1986) were examined for data including hatchery, date, species, disease, and number and percent mortality. The type and amount of medication used to treat the epizootic was not available in WDW fish pathology reports. Data includes epizootics observed from January, 1983 to June 30, 1986.

Beaver Creek

Of the viral diseases, IHN epizootics occurred in 1983 in winter steelhead and cutthroat. Winter steelhead (406,000) and cutthroat (90,000) were destroyed. The percent mortality for the fish was not recorded. Furunculosis was an annual problem at Beaver Creek with coldwater disease occurring in 1984 and 1985. The number and percent mortality attributed to the two bacterial diseases was not recorded.

Cowlitz

Coldwater disease epizootics were seen at Cowlitz in cutthroat in January, 1983 and winter steelhead in July, 1985. Ceratomyxosis is an annual occurrence at Cowlitz in all fish reared at the station. Estimates of the mortality attributed to ceratomyxosis in steelhead and cutthroat have ranged from 30 to 80 % (Tipping et al., 1984). The actual numbers and percent mortality for the coldwater disease and ceratomyxosis were not recorded.

Lyons Ferry

At Lyons Ferry hatchery, a coldwater disease epizootic was noted in May, 1986. The number and percent mortality were not recorded.

Skamania

IHN epizootics occurred at Skamania hatchery in summer steelhead and cutthroat in April, 1983. Cutthroat (49,000) were destroyed. The percent mortality due to IHN was not recorded. Coldwater disease was seen in 1984, 1985, and 1986 in summer steelhead and cutthroat. The actual numbers and percent mortality for the coldwater disease was not recorded.

Turtle Rock

IHN was diagnosed in summer steelhead smolts reared at Turtle Rock in April, 1986. The fish were not destroyed. The actual mortality due to IHN was 9,000 fish or 4.7%.

Vancouver

In June, 1985 furunculosis was noted in summer steelhead reared at Vancouver hatchery. The actual numbers and percent mortality due to the furunculosis was not recorded.

A summary of the epizootics which occurred at WDW Columbia basin hatcheries and rearing ponds follows in Table 25.

Table 25. Summary of epizootics from WDW Columbia River Basin hatcheries, January, 1983 to June, 1986.

Hatchery	Date	Species	Disease	Mortality	
				No.	%
Beaver Creek	May-83	SW	IHN	110,000	1/ NR
Beaver Creek	Jul-83	ss	Furunculosis	NR	NR
Beaver Creek	Jul-83	CT	Furunculosis	NR	NR
Beaver Creek	Jul-83	CT	IHN	90,000	1/ NR
Beaver Creek	Jul-83	CT	Furunculosis	NR	NR
Beaver Creek	Ott-83	SW	IHN	296,000	1/ NR
Beaver Creek	Apr-85	SW	Furunculosis	NR	NR
Beaver Creek	May-85	SW	Coldwater Disease	NR	NR
Beaver Creek	Aug-85	CT	Furunculosis	NR	NR
Beaver Creek	Sep-85	CT	Furunculosis	NR	NR
Beaver Creek	Mar-86	SW	Coldwater Disease	NR	NR
Beaver Creek	Mar-86	SW	Furunculosis	NR	NR
Cowlitz	Jan-83	ss	Ceratonyxosis	NR	NR
Cowlitz	Jan-83	CT	Ceratonyxosis	NR	NR
Cowlitz	Feb-83	SW	Ceratonyxosis	NR	NR
Cowlitz	May-83	SW	Ceratonyxosis	NR	NR
Cowlitz	Jun-83	CT	Coldwater Disease	NR	NR
Cowlitz	May-83	SW	Ceratonyxosis	NR	NR
Cowlitz	Ott-83	SW	Ceratonyxosis	NR	NR
Cowlitz	Jan-84	SW	Ceratonyxosis	NR	NR
Cowlitz	Feb-84	SW	Ceratonyxosis	NR	NR
Cowlitz	Mar-84	SW	Ceratonyxosis	NR	NR
Cowlitz	Nov-84	SW	Ceratonyxosis	NR	NR
Cowlitz	Nov-84	ss	Ceratonyxosis	NR	NR
Cowlitz	Jul-85	SW	Coldwater Disease	NR	NR
Cowlitz	Jul-85	SW	Coldwater Disease	NR	NR
Cowlitz	Sep-85	CT	Ceratonyxosis	NR	NR
Cowlitz	Sep-85	SW	Ceratonyxosis	NR	NR
Cowlitz	Sep-85	ss	Ceratonyxosis	NR	NR
Cowlitz	Nov-85	CT	Ceratonyxosis	NR	NR
Cowlitz	Nov-85	ss	Ceratonyxosis	NR	NR
Lyons Ferry	May-86	ss	Coldwater Disease	NR	NR
Skamania	Apr-83	ss	IHN	NR	NR
Skamania	Apr-83	CT	IHN	49,000	1/ NR
Skamania	Jan-84	ss	Coldwater Disease	NR	NR
Skamania	Jun-85	CT	Coldwater Disease	NR	NR
Skamania	Aug-85	SS	Coldwater Disease	NR	NR
Skamania	Jul-86	SS	Coldwater Disease	NR	NR
Turtle Rock	Apr-86	ss	IHN	9,000	4.7
Vancouver	Jun-85	ss	Furunculosis	NR	NR

ss = Summer Steelhead
 SW = Winter Steelhead
 CT = Cutthroat

NR = Not recorded

Note: 1/ Mortality includes disease losses and fish destroyed

Task 6.1.4 Feed Conversion

Data from WDW hatchery reports were entered into a Lotus 1-2-3 worksheet. Calculations were made that includes total pounds of feed fed per total pounds of fish produced. Work has been completed for all eastern Washington operations for broodyears 1983 to 1985 except Lyons Ferry.

Average overall feed conversion for the five summer steelhead production lots was 1.68, 1.31, and 1.09 for 1983, 1984, and 1985 respectively. For the average of the three years, Wells had the best feed conversion with a 1.23 followed by Chelan - Turtle Rock with 1.25. A summary of the feed conversions for the eastern Washington WDW steelhead except Lyons Ferry for 1983 to 85 broodyears is contained in Table 26.

Table 26. Feed conversion for steelhead lots.

Lots (Hatchery)	Feed Conversion (Broodyears)			
	1983	1984	1985	Avg.
Chelan	1.36	1.26	1.16	1.26
Chelan - Turtle Rock	1.67	1.35	0.73	1.25
Naches - Nelson Springs	1.92	1.19	1.15	1.42
Wells	1.39	1.59	0.72	1.23
Yakima - Columbia Basin - Ringold	2.08	1.18	1.69	1.65
Average	1.68	1.31	1.09	1.36

Task 6.1.5 Report Total Survival of Smolt to Adult Stage at "Index" Hatcheries with Tagging Programs

No work has been done on this task.

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